ECOLOGY OF UPPER KLAMATH LAKE SHORTNOSE AND LOST RIVER SUCKERS

I. Adult and larval sampling in the lower Williamson River, April–August 1999

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ANNUAL REPORT (partial)

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Introduction

In 1999 we temporarily took over adult sampling of shortnose sucker, SNS, (*Chasmistes brevirostris*), Lost River sucker, LRS, (*Deltistes luxatus*) and Klamath largescale sucker, KLS, (*Catostomus snyderi*) in the lower Williamson River. Previously, Biological Resources Division (BRD) of the United States Geological Survey had conducted this survey to assess population size, age structure and overall fish condition of suckers. We continued that time series using BRD protocols. In addition, we added larval sucker sampling to assess relationships between larval production, timing of adult migrations, and adult abundance. Where possible, we compared our results with data from previous years.

Methods

Adult Sucker Sampling

We followed BRD protocol (Perkins 1997, Perkins et al. 1998) and sampled adult suckers with trammel nets. Nets were 91 m long, 1.8 m high, and made of two 30 cm mesh outer panels, a middle panel of 3.8 cm mesh, a foamcore float line, and a leadcore bottom line. The sampling area (Figure 1) was approximately 1km upstream from the mouth of the Williamson River. Water depths were up to 4 m and river width was about 100 m.

Samples were collected at four fixed sites (Figure 1), 3-5 days per week from April 13 through August 3, 1999 (a total 688 sets and 1,514 net hours on 59 days). Nets were set diagonally from shore downstream at a 30°-60° angle. A trammel net was deployed at each fixed site and retrieved three times each day. All nets were fished between 0430 and 1500 hours, with an average soak time of 2.2 hours per net. Nets were retrieved prior to 0800 hr on 172 sets, between 0800 –1000 hr on 232 sets and after 1000 hr on 284 sets. Retrieval of nets was in the same order in which they were set. To reduce handling and stress, captured suckers were cut from the net and placed immediately into a 70 gallon holding tub inside the boat.

Each adult sucker captured was identified to species, measured (fork-length in mm), examined for sex and spawning condition (determined by abdominal stroking), examined for various afflictions (such as parasites, wounds, deformities), and PIT (Passive Integrated Transponder) tagged. PIT tags were inserted ventrally into the body cavity anterior to the pelvic girdle. Of 383 suckers captured, 22 were identified as hybrids and were separated from other species in the analysis. Other fishes were identified, measured, and promptly released.

Catch per unit effort (CPUE) as number of fish/hour was determined for each net, and a mean CPUE was calculated for each day (N=12). BRD protocol considers SNS and KLS > 299 mm and LRS> 399 mm to be adults. A standardized index of abundance, A, (Perkins et al. 1998) was calculated for adults by summing daily mean CPUE for nets retrieved between 0800 and 1900 hr and interpolating for days not sampled by assuming a linear trend between sample days. The standardized index is calculated using samples when catch rates were lowest (i.e. after 0800 hrs). We also calculated A for nets retrieved before 0800 when catch rates were highest.

Larval Sucker Sampling

Larval fish sampling was conducted from the Modoc Point Road Bridge on the Williamson River from May 5 through August 3, 1999 (Figure 1). The ring net mouth opening was 30 cm diameter and the net was 2 m long and constructed of 800 micrometer mesh Nitex. A calibrated Kahlisco flow meter, suspended in the mouth of the net, was used estimate volume of water filtered. The net was set on the downstream side of the bridge, below the water surface in the section of river with highest flow. One 10 minute sample was collected before sunrise each morning of trammel net sampling. All larval fish collected were immediately preserved in a 10% formalin solution, then sorted and transferred into a 70%

alcohol solution within 48 hours. Preliminary results of larval sampling are reported as CPUE in number of fish per ten minute tow.

Results and Discussion

Adult CPUE patterns

Logistical problems prevented us from sampling before April 13. Perkins et al. (1998) found migrating adults as early as February in other years, so we probably missed part of the spawning migration. Average daily CPUE of all adult suckers early in our sampling were as high as any other period suggesting we may have missed a significant part of the migration (Figure 2).

Adult abundance values (A) for nets retrieved after 0800 were: SNS – 8.7, LRS - 1.1, KLS – 4.5 (Figures 3-5). Perkins et al. (1998) report SNS A values declining from 175 in 1995 to 9 in 1998 and LRS A values declining from 20.6 in 1995 to 3.3 in 1998. The 1999 results continued the declining trend. Even when nets pulled before 0800 were included, the increase in abundance estimates (SNS – 12.0 and LRS - 1.5) were far below the 1995 and 1996 values (Perkins et al. 1998).

This valuable data set presents a number of analytical challenges related to sampling logistics and fish behavior (Perkins 1997, Perkins et al.1998). Interannual comparisons of these data are compromised by different start dates, from mid-February (1998) to mid-March (1995) in Perkins et al.(1998) to mid-April in our data set. Stop dates also differed, being as early as late May in 1998 (Perkins et al. 1998) and as late as early August in our data set. During two sampling years, 1995 and 1999, catches on the first sampling date were about equal to the maximum rates of the season, suggesting underestimation of abundance of early spawners.

In addition, trammel net catches are dependent on fish behavior. Over the sampling time frame, catches for all suckers were highest in early morning before 0800 (Figure 6). The standardized abundance metric (A) attempts a first order correction by restricting the analysis to nets retrieved after 0800. However, the difference in CPUE between samples collected from 0800-1000 hr and those collected after 1000 hr is also problematic. Catch rates drop by about 50% between these two time periods (Figure 6). Therefore, inter- or intra-annual differences in time-of-day effort could add to perceived differences in spawning group abundance.

Cues other than time of day may also be important in the timing of movements. Patterns in sucker CPUE tended to approximate a lunar pattern with lower catches coinciding with the full moon (Figure 2). Perkins et al.(1998) noted that temperature appeared to cue migrations with peak migrations occurring at 10-15C. We found similar temperature ranges during migrations. The combination of lunar phase (Gibson, 1978, Kavaliers, 1982), temperature cues, and river flow may drive patterns in CPUE.

With one exception, all ripe suckers were caught before June 23. However, adult suckers continued to be vulnerable to our fishing gear throughout the sampling period (Figure 2). If there is residual use of the lower Williamson R. by non-spawning suckers, we may overestimate the size of the spawning run. For example, if residual use by non-spawning adults normally contributes 0.25 to the CPUE, then the overestimate will be close to 50% in low abundance years such as 1999 but less than 10% in high abundance years such as 1995 or 1996 (Perkins et al, 1998).

Perkins et al. (1998) and we have had difficulty assigning spawning condition to migrating suckers. In part, the difficulty arises from the desire to minimize handling and stress on the fish. Except for tuberculate, running ripe fish, characteristics of spawning condition are subjective (such as a full, firm body cavity, which we presume indicates presence of gametes). Perkins et al. (1998) and we have used body size as a surrogate for including an individual in the estimate of spawning run size. Again our procedures may overestimate the size of the spawning run.

Larval CPUE Patterns

Larval suckers first appeared in the drift when water temperatures reached 11° C. There were two peaks in larval abundance around the end of May and middle of June (Figure 7). Hoff et al. (1997) found the youngest larvae caught in the lower Williamson R. were 11 (LRS) to 13 (SNS) days old. If we assume that larvae drifting by Modoc Point Rd. Bridge were about two weeks old and that egg development took another two weeks, then adults should be detected about one month prior to the arrival of larvae. The first peak in larval abundance at the end of May does not correspond to the mid-April peak in adult abundance (Figure 7). However, the second peak in larval abundance in mid-June did correspond well with the May adult peak. The greater lag between the first adult peak and the first larval peak might be due to adults staging in the river prior to spawning and/or to slower embryonic development at lower May temperatures. The third adult peak in abundance in later June corresponded to low, but steady, larval production through early July (Figure 7) and thus does not appear to represent a major part of the spawning migration. Perkins et al. (1998) routinely stopped sampling in early June and would have missed this third adult peak. However, relatively few of these fish were ripe and it appears they do not contribute much to larval production. The peak may represent residual use of the lower river by adult suckers.

Although late larval production appears low, it may be very important. Simon et al. (2000) report that median hatchdate of juvenile survivors in September is often early June. Assuming the larvae represented in Figure 7 are two weeks old and 1999 September survivors have early June birthdates, then about half of the survivors would come from larvae detected after June 15, from the small right hand tail of the larval distribution (Figure 7). Sampling of adult migrators does not adequately reflect this important component of larval production. Future work should focus on understanding the maternal and ecological relationships responsible for this pattern.

Adult Sucker Size and Condition

Shortnose suckers were mostly less than 350mm FL (Figure 8). Specimens larger than 350 mm, which had been present during 1997 and 1998 (Perkins et al.1998), were largely absent in 1999. The size frequency distribution was most similar to the 1995 sampling during which the large 1991 year class first recruited (Perkins et al.1998). If larger fish spawn first as suggested by Perkins et al.(1998), the absence of larger fish may simply be due to the later start date for 1999 sampling.

Lost River suckers had a broad size range up to 609mm FL (Figure 8). However, only 22 were captured in 1999.

Cysts were found in 35.1% of all SNS and 40.7% of all LRS in 1999, compared to 2.3% and 3.2%, respectively, in 1997 (Perkins 1997). The occurrence of the parasite, *Lernaea sp.,* was 38.7% for SNS and 25.9% for LRS, down from 84% and 56%, respectively, in 1997. Lamprey wounds were found on 17.1% of SNS and 29.6% of LRS, up from 16% and 19%, respectively. Various eye afflictions, fin damages, and other deformities were recorded for fish as well, but occurred in only a small percentage of fish captured.

Conclusion

Abundance of adult suckers as measured by trammel net CPUE continued a decline that had been detected in 1997 and 1998. The late (April 13) start date for sampling in 1999 data might have contributed to underestimating abundance. The inclusion of data after June 1 might have contributed to overestimating abundance. If non-spawning adult suckers utilize the lower Williamson and are inadvertently included as spawners based on size (Figure 2), we would also overestimate abundance. Despite these difficulties, we agree with Perkins et al. (1998) that interannual comparisons using these data are robust enough, and the decline in abundance sever enough, to conclude that the Williamson R. spawning run has experienced a precipitous decline between 1995-96 and 1997-99.

Further refinements in interannual comparisons can be made based on further modeling of time-of-day effort (Figure 6). One approach is to limit the abundance index as in the current protocol. Our data suggest that even with the index limited to samples collected after 0800, there may be important differences between mid-morning and later samples (Figure 6). The index could be based only on early morning samples (0430-0800 in our data set). However, the logistics of early morning sampling would likely reduce total sample size. For example, early morning samples made up only 25% of our 688 samples. Alternatively, the abundance index could be standardized by time of retrieval. One standard is the combined 1995-1999 data set, which could be standardized by time of retrieval, and abundance estimated each year from the residuals of that relationship.

An alternative approach to estimating adult abundance may be available if the apparent residual use of the lower Williamson River is better understood. Above, we suggest that residual use by non-spawning adults might contribute a constant CPUE such as 0.25. It is also possible that residual use is a constant proportion of the adult spawning population. Thus, residual use in June and July might represent a constant proportion of the spawning migration CPUE. Several more years of data and analyses are needed to establish the validity of any such relationship. The importance of establishing the relationship is the ability of researchers to avoid handling ripe fish and the unknown consequences of those activities. Sampling of non-spawning adults could be coupled to larval production monitoring. The negative aspect of this approach is that summer temperatures may make handling of fish as detrimental as handling spawners and the size structure of residual fish may not reflect the size structure of spawners.

Abundance of larval suckers at Modoc Pt. Rd. Bridge generally corroborated the patterns seen in adults (Figure 7) but provided a different perspective. If we correctly matched adult and larval abundance patterns, the larval production from adults migrating in April was delayed 2-3 weeks compared to the production from adults migrating in May (Figure 7). The delay could be due to colder temperature at development and/or to longer staging in the river by the April fish. The ability to match adult and larval abundance patterns is dependent on duration and variability of staging and duration and number of an individual's spawning bouts. For example, we do not know the duration of staging for an individual fish.

The low but steady level of larval production in late June and early July contrasted with the more sudden rise in production in late May (Figure 7). The sudden early rise may be a predator swamping mechanism and may account in part for the apparent high survivorship of late produced larvae. Future investigations of relationships between maternal health or quality and timing of spawning and between birthdates and subsequent survivorship could address these issues.

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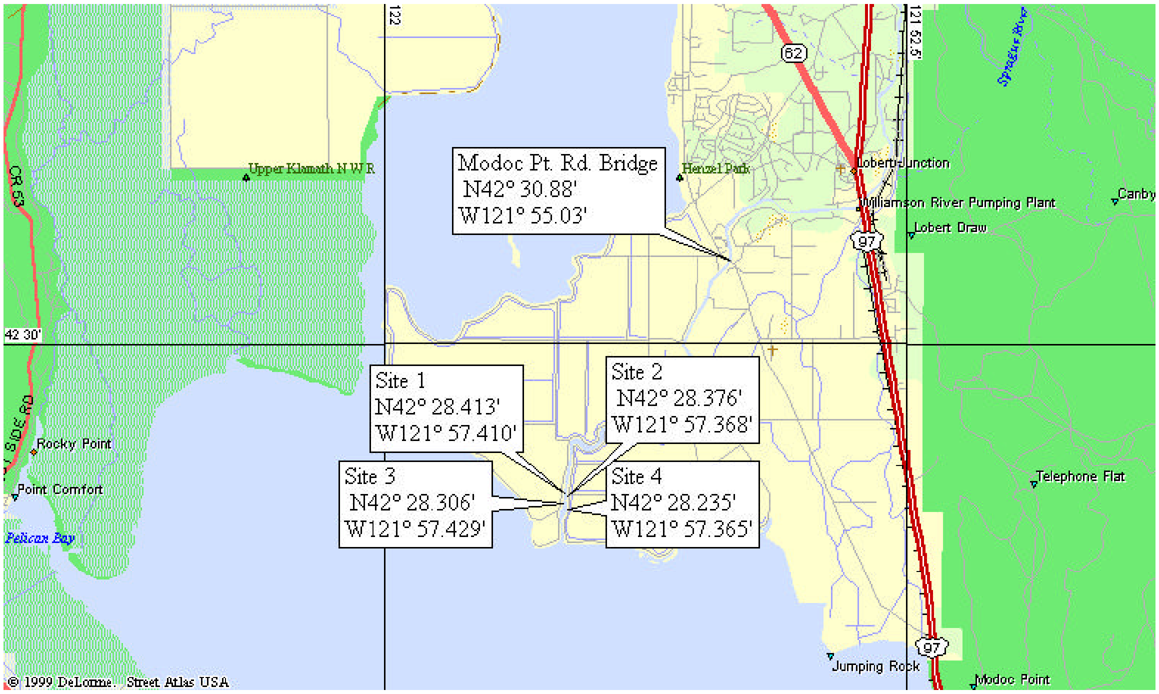

Figure 1. Map of lower Williamson River showing locations of trammel net sites, 1-4, and larval drift site at Modoc Pt. Rd. Bridge.

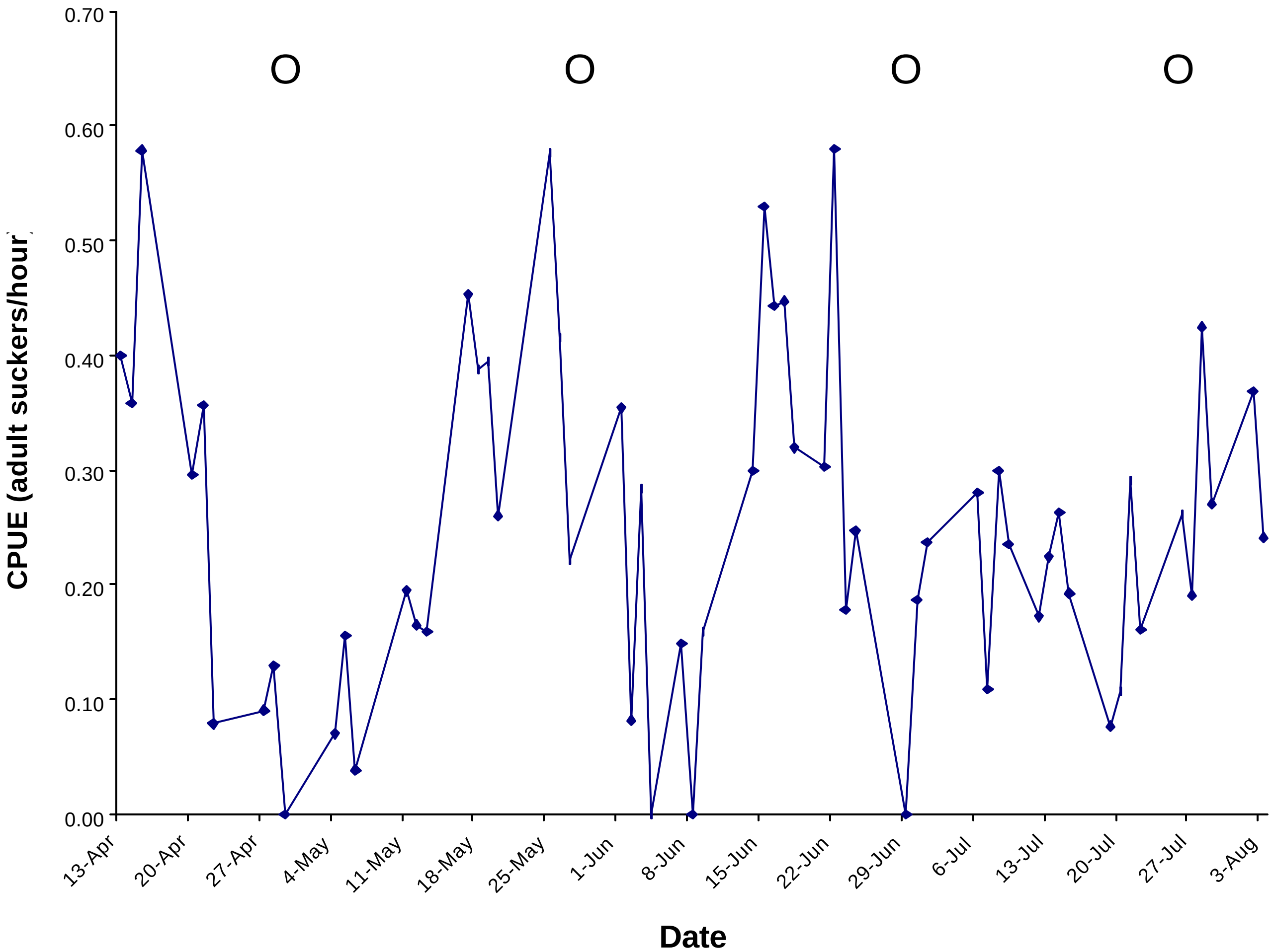

Figure 2. Mean CPUE for all adult suckers caught in trammel nets in lower Williamson R., 13 April – 3 August 1999. Circles indicate times of full moon.

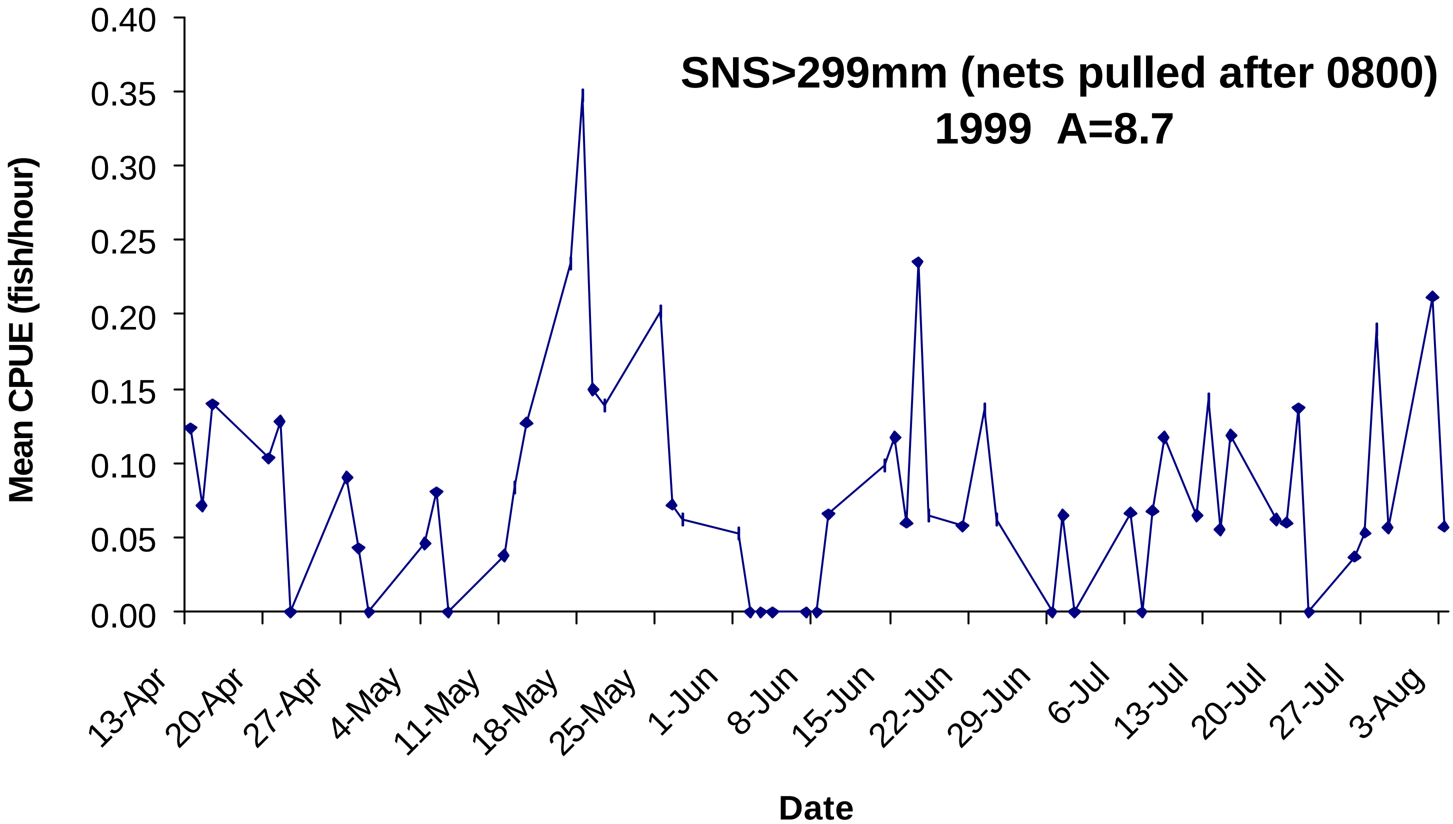

Figure 3. Mean trammel net CPUE for adult shortnose suckers in lower Williamson River, 1999.

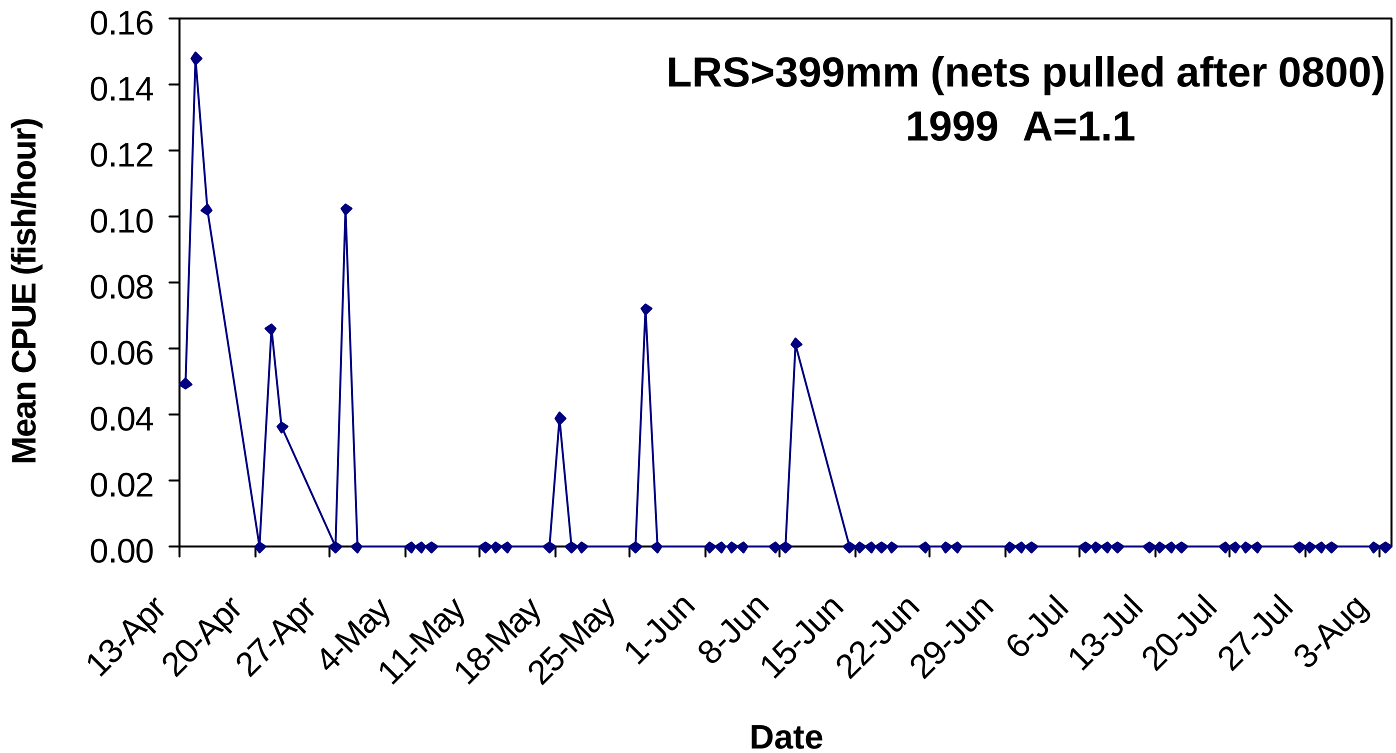

Figure 4. Mean trammel net CPUE for adult Lost River suckers in lower Williamson River, 1999.

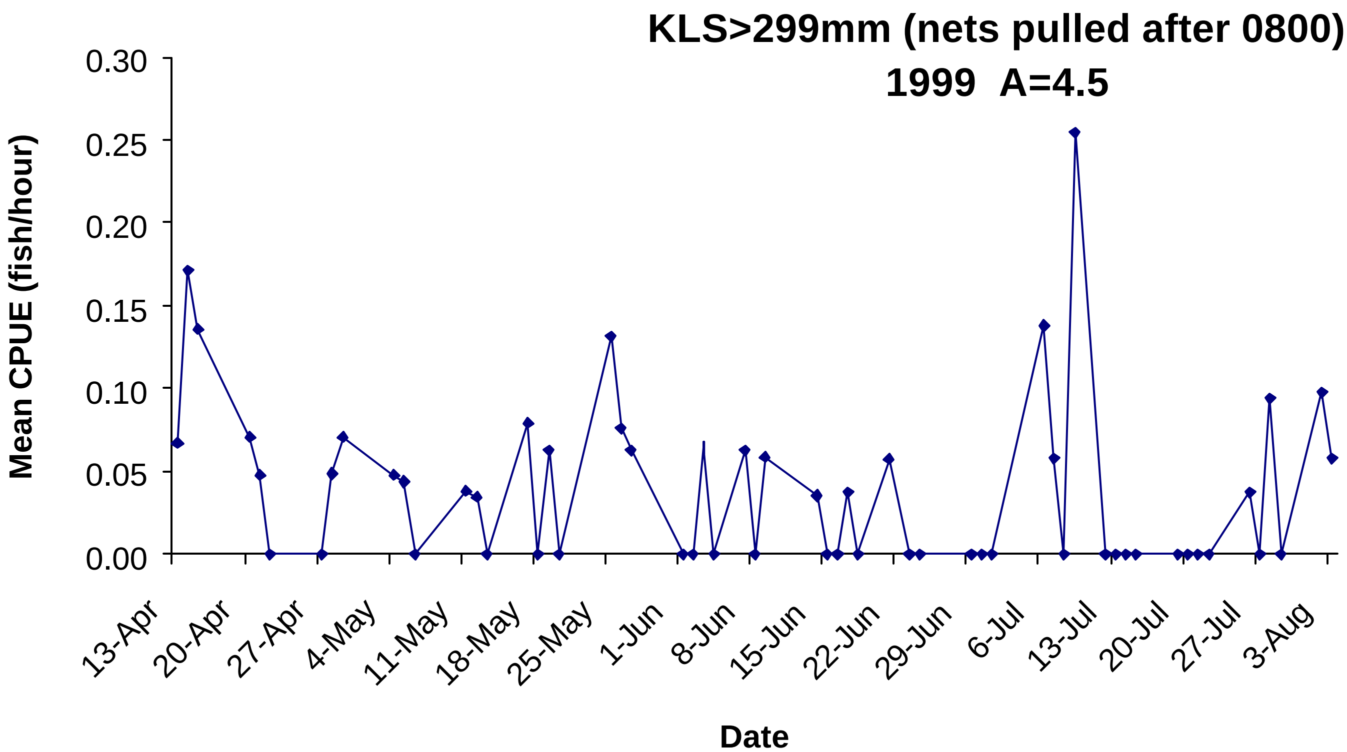

Figure 5. Mean trammel net CPUE for adult Klamath largescale suckers in lower Williamson River, 1999.

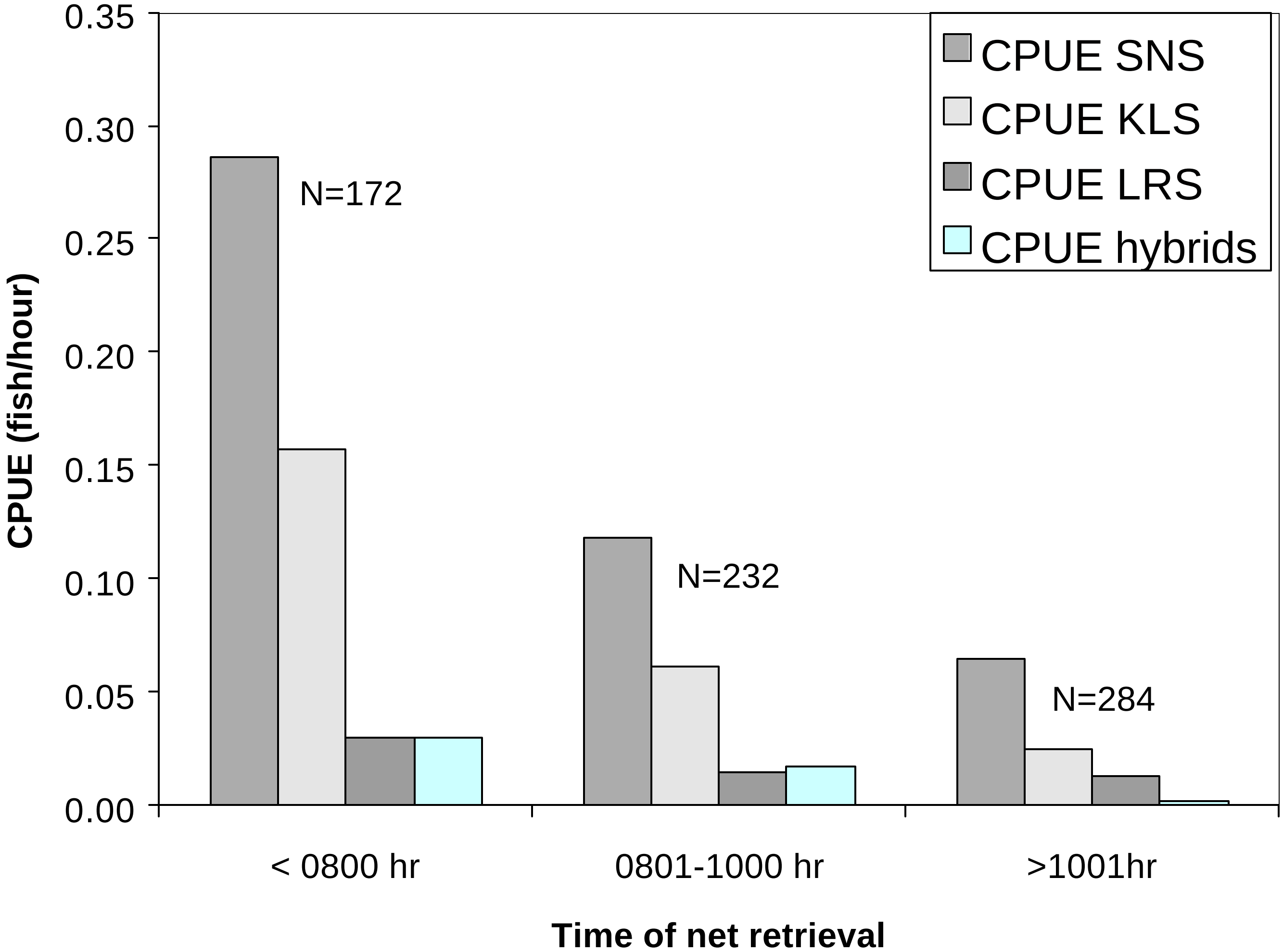

Figure 6. Comparison of sucker CPUE in lower Williamson River by time of net retrieval.

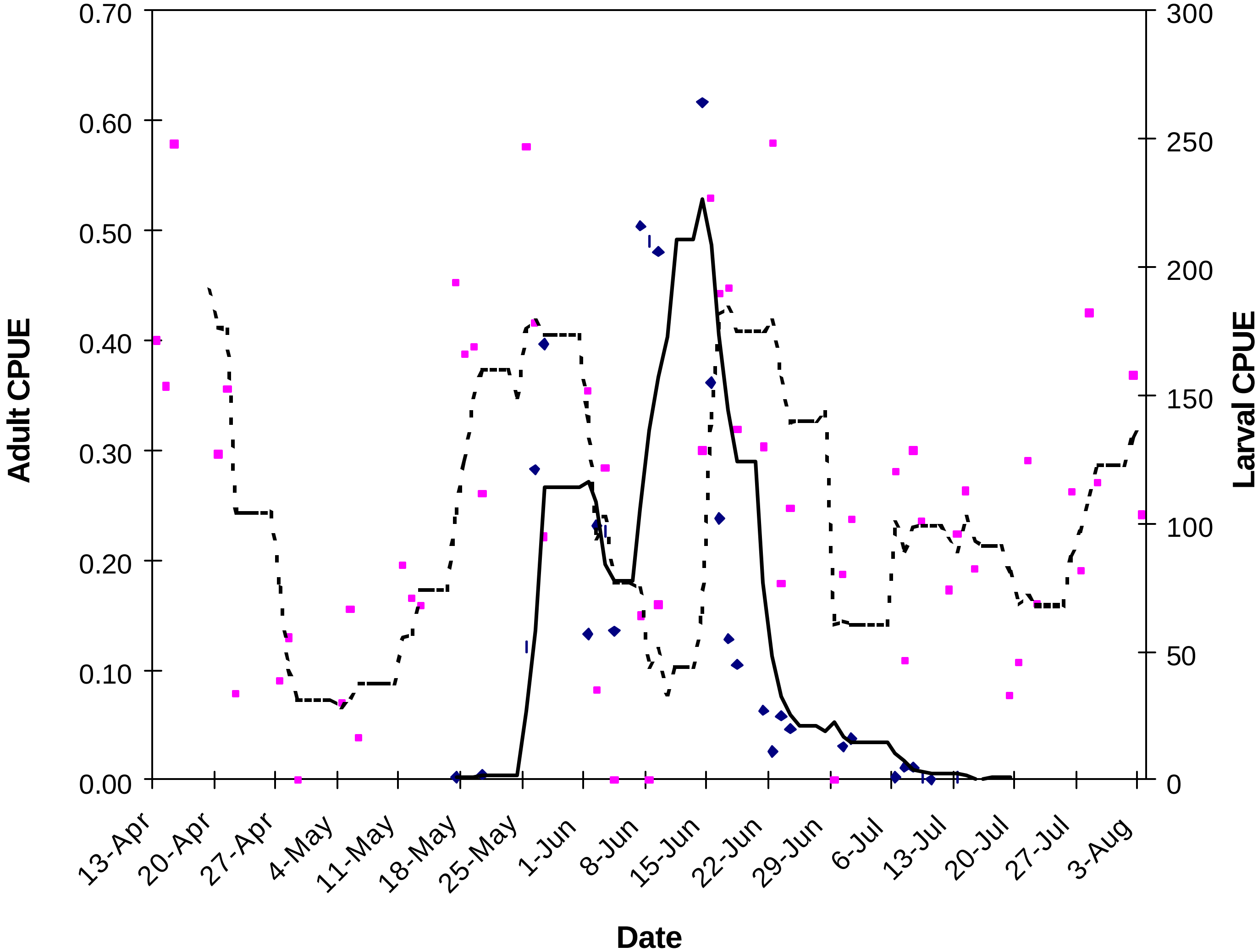

Figure 7. Comparison of adult sucker CPUE (squares) and 7-day moving average (dashed line) from lower Williamson trammel nets with larval sucker CPUE (diamonds) and 7-day moving average (solid line) from Modoc Point Rd. Bridge, 1999.

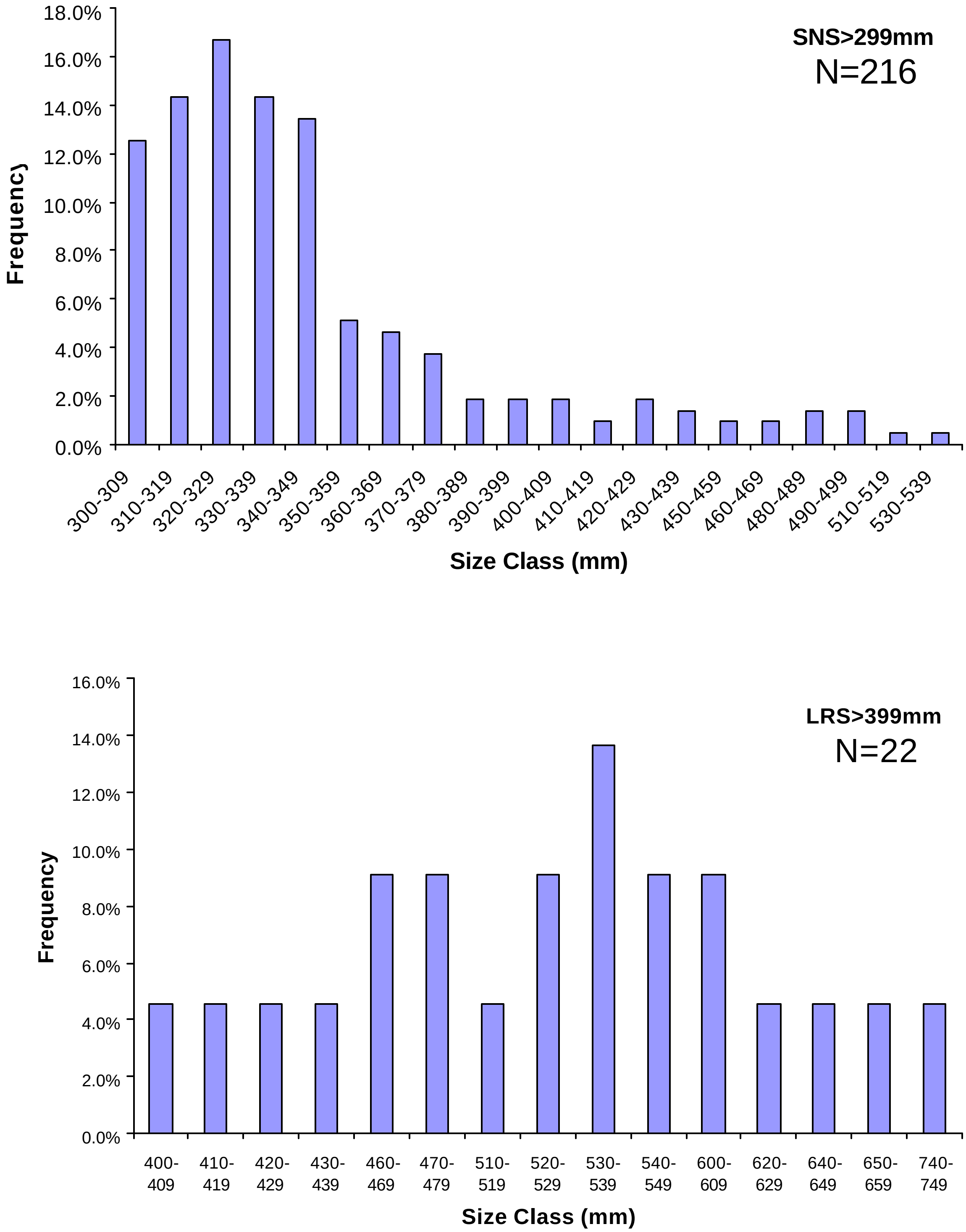

Figure 8. Size frequency distributions of adult suckers from the lower Williamson R., 1999. Upper - shortnose sucker; lower – Lost River sucker.